Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC

In the Matter of	)	
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Office of Engineering and Technology Invites	)	
Comments on Technological Advisory Council	)	ET Docket No. 13-101
(TAC) White Paper and Recommendations for	)	
Improving Receiver Performance	)	

COMMENTS OF MOTOROLA SOLUTIONS, INC.

Motorola Solutions, Inc. ("MSI") submits these comments in response to the Federal Communications Commission ("Commission") Public Notice seeking comment on the White Paper and Recommendations for Improving Receiver Performance prepare by the Commission's Technological Advisory Council ("TAC").[1] MSI supports the efforts of the Commission and the TAC to identify new approaches to address interference issues in densely-packed spectrum.

The Interference Limits approach has significant potential and warrants further exploration. MSI agrees with the premise that such an approach is preferable to mandatory regulator-enforced receiver specifications (*i.e.*, "receiver mandates")[2] that are not market-driven and limit both innovation and flexibility in responding to customer needs. MSI supports the continued development of receiver operating requirements within well-known industry bodies, such as TIA and IEEE, as well as the establishment of a web-accessible repository of existing

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[1] Office of Engineering and Technology Invites Comments on Technological Advisory Council (TAC) White paper and Recommendations for Improving Receiver Performance, ET Docket No. 13-101, *Public Notice*, 28 FCC Rcd 5274 (2013) ("Public Notice"); *see also* FCC Technological Advisory Council, White Paper: Interference Limits Policy; The Use of Harm Claim Thresholds to Improve the Interference Tolerance of Wireless Systems (Feb. 6, 2013) *available at* http://transition.fcc.gov/bureaus/oet/tac/tacdocs/WhitePaperTACInterferenceLimitsv1.0.pdf ("TAC White Paper").

[2] TAC White Paper at 8.

industry and receiver standards that could be linked to the Commission's spectrum dashboard. Similarly, we generally support the use of multi-stakeholder groups to fine-tune the harm claim thresholds utilized in the Interference Limits approach.[3] Several existing industry bodies (*e.g.*, TIA, IEEE, Wireless Innovation Forum, *etc*.) may be able to facilitate the rapid formation of such groups.

The Interference Limits approach generally considers both in-block and out-of-block interference levels and harm claim thresholds.[4] MSI suggests an extension of the in-block (in-band) Interference Limits approach to not only include unintentional or out-of-band emissions (OOBE) effects from transmitters operating in adjacent (or generally out-of-block) bands, but also to include the effects of *intentional* radiators within the band or nearby bands. In many cases, due to the dense packing of disparate services, adjacent services may be considered as in-block or in-band.[5] This suggested approach may allow system designers to better quantify the interfering effects of nearby strong signals, to better address intermodulation and cross-modulation distortion and interference in realistic receivers. Strong signal blocking (or desensing) effects are a significant cause of interference in many systems, due to receiver non-linearities in realistic implementations. By placing *a priori* limits on the maximum expected intentional in-band (or in-block) signal levels, strong signal interference from nearby competing systems can be better addressed by system designers.[6] In this manner, interference limits may be

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3 *Id.* at 13.

4 *Id.* at 51.

5 The early 800 MHz interleaved SMR band is an example of this scenario.

6 For example, in the 700MHz band, part 90.542(b) requires maintaining the power flux density below a 3000μW/m^2 limit on the ground within 1 km of the base of the antenna system. 47 C.F.R. § 90.542(b). This corresponds to roughly a 120dBμV/m value (or about -14dBm into

computed (generally based on industry standards) for both intentional and unintentional signal sources to improve system performance. In order to be most effective, such interference limits should be determined well before competing system roll-outs.

In order to more thoroughly study the performance of the proposed Interference Limits approach, we concur that the approach should be further developed on a trial basis. The planned enhanced sharing of the 3.5 GHz band may provide a good opportunity to exercise the Interference Limits concepts.[7] A wide variety of services and technologies (*e.g*., incumbent systems, commercial small cell deployments, public/life-safety systems, WLAN systems, *etc*.) will occupy the band and will require extensive coordination through a database. The proposed Interference Limits methods will enhance the coordination and coexistence among services. The Spectrum Access System (SAS) database proposed for the band could be utilized to maintain and distribute the interference limits information. Furthermore, the database system also could be utilized to collect sensor information on the interference environment where possible, to alert users and authorities to the possibility of excessive interference levels. A set of interference limits could be derived for the band from industry standards and recommendations from multi-stakeholder groups.

MSI agrees that it is critically important to stress the wide range of variability in the "harm claim thresholds" (probabilistic thresholds) for determining harmful interference for different types of services (e.g., consumer, commercial/industrial, mission critical).[8] The use of

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a 0dBi gain antenna). In 3GPP LTE systems, the maximum UE input level is specified at -25dBm, which would correspond to a 109dBμV/m level at 698MHz (assuming a 0dBi gain antenna).

[7] *See e.g.* Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, GN Docket No. 12-354, Notice of Proposed Rulemaking, 27 FCC Rcd 15594 (2012).

[8] TAC White Paper at 11-12.

such statistical interference models is generally supported in many cases, though great care must be utilized when applying such models to mission-critical systems. For example, public safety communications systems may already have 97%+ coverage reliability requirements, resulting in the need for very high harm claim probabilistic thresholds (*e.g.*, in excess of 99%) in order to not negatively impact critical services.[9] Likewise, the spatial and time measurement grid for performing such interference measurements may require very high resolution (*e.g.*, on the order of 5 meters and 10 milliseconds) in order to adequately capture harmful interference cases for mission critical systems. Until these items are fully understood and agreed upon, MSI does not recommend applying these techniques to mission critical or life-safety systems. In many cases, consumer-grade services generally will not have these same high levels of requirements.

Finally, the measurement methods used to determine harmful interference levels (in excess of the harm claim thresholds) must be carefully specified. Highly controlled measurements (*e.g.*, specifying antenna gains, heights, polarization, etc.) using precision test equipment should be utilized in any determination of harm claim thresholds being exceeded. While other methods (*e.g.*, the lower accuracy subscriber equipment-based measurements described above) may be useful to determine the possibility of exceeding specified interference limits, the final determination should be more rigorous. It is assumed that interference disputes would be initially addressed within the multi-stakeholder groups that are formed for the band.

MSI supports further exploration of the Interference Limits approach. If appropriately implemented, the Interference Limits approach could be useful in evaluating receiver

[9] An example harm claim threshold could be that the interference levels shall not exceed some predetermined level more than 0.5% of the time, or at 0.5% of the locations (for a 99.5% threshold) to be considered non-harmful. Additionally, this determination would need to be made with a very high confidence level.

performance in various operating conditions. In particular, MSI believes the Commission should consider conducting a trial of the Interference Limits approach to gauge its merits.

Respectfully submitted,

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